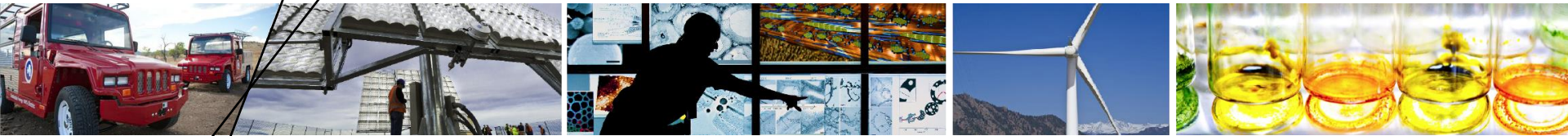# Energy Efficiency Related Lessons Learned

Kevin Regimbal

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Event 1: May 12 – Background

- Planned troubleshooting activity required power down / lock out of electrical panel that powers the Building Automation System (BAS) panels that manage data center cooling systems.

- Similar activities had been performed without impact to the data center cooling systems, so it was believed this work would not affect cooling.
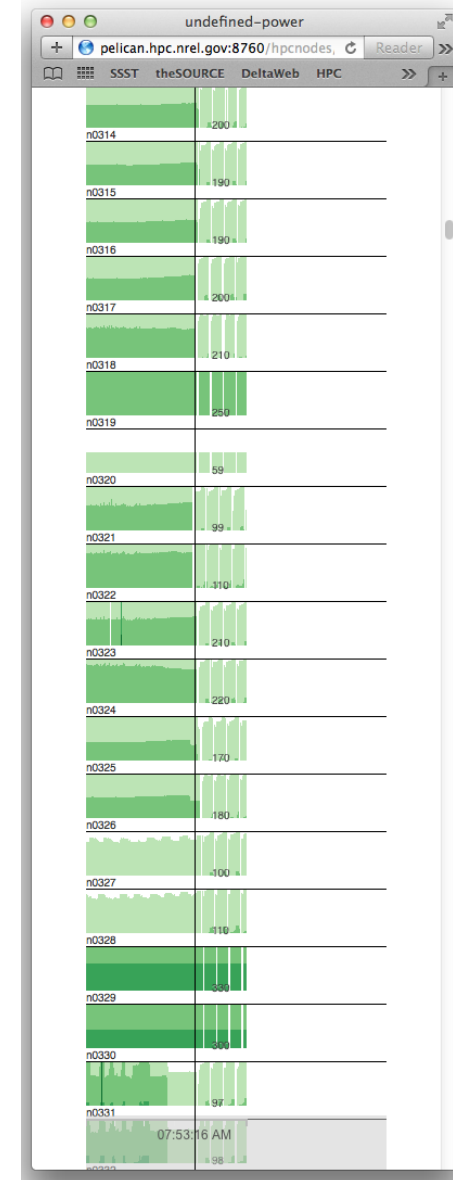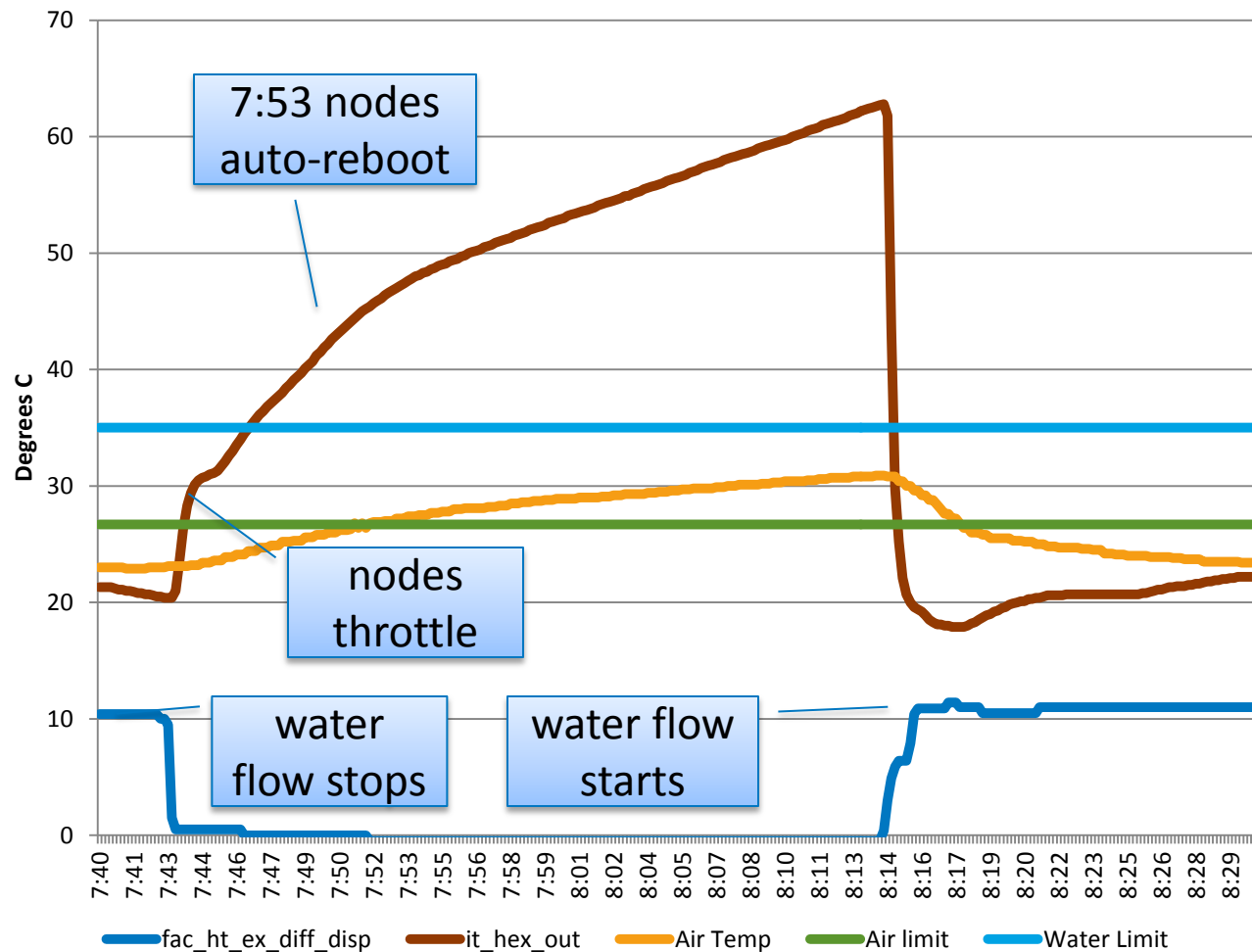
Event 1: May 12 – Data Center Sequence of Events

- ~7:40 AM BAS control panels that controlled the energy recovery loop pumps for the Data Center cooling system were de-energized.
- Valves for the energy recovery loop closed.
- Loss of flow was detected at 7:43.

- The BAS was restored at ~ 8:10 AM.

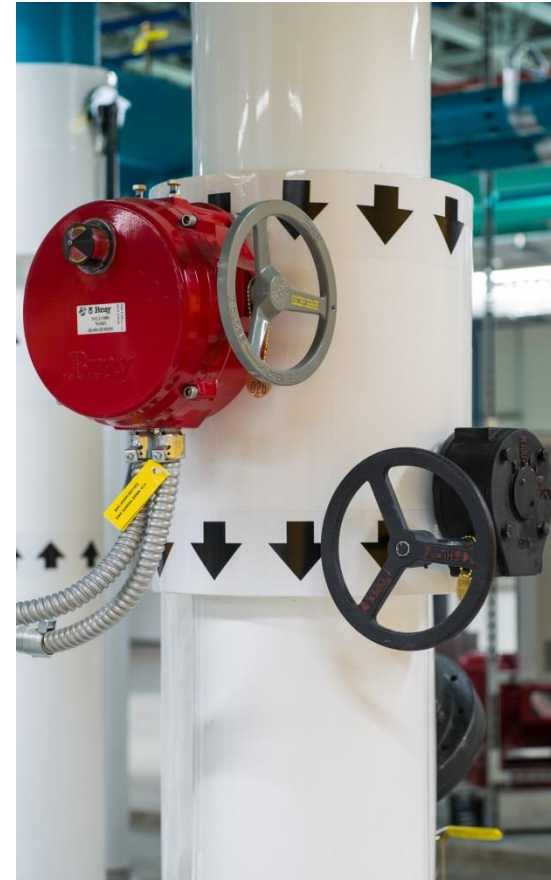# Event 1: May 12 Air and Water Temps

Event 1: May 12 – Learnings

- Test systems so you know how they will work when:
  - Normal power is interrupted
  - Emergency power interrupted
  - A BAS panel fails
  - Smoke Detectors are tested
- Validate that computer systems will protect themselves in a loss of cooling event.

Event 2: May 14 – Background

- In the process of investigating and implementing improvements related to event 1, the building engineering team noticed that one of the energy recovery heat exchanger valves was in local bypass and manual open.

- Not finding any reason for the valve to be in bypass, they returned the valve to building control and verified that it closed properly in response to BAS signal.

- 2 hours later, the energy recovery loop switched to energy recovery mode.

- The BAS signaled for the bypass valve to close (it did) and the ER HX valve to open (it did not).

- This left no path for cooling water to flow.

- Why: The control module for the ER HX valve was not fully seated in the panel.

# Graphic
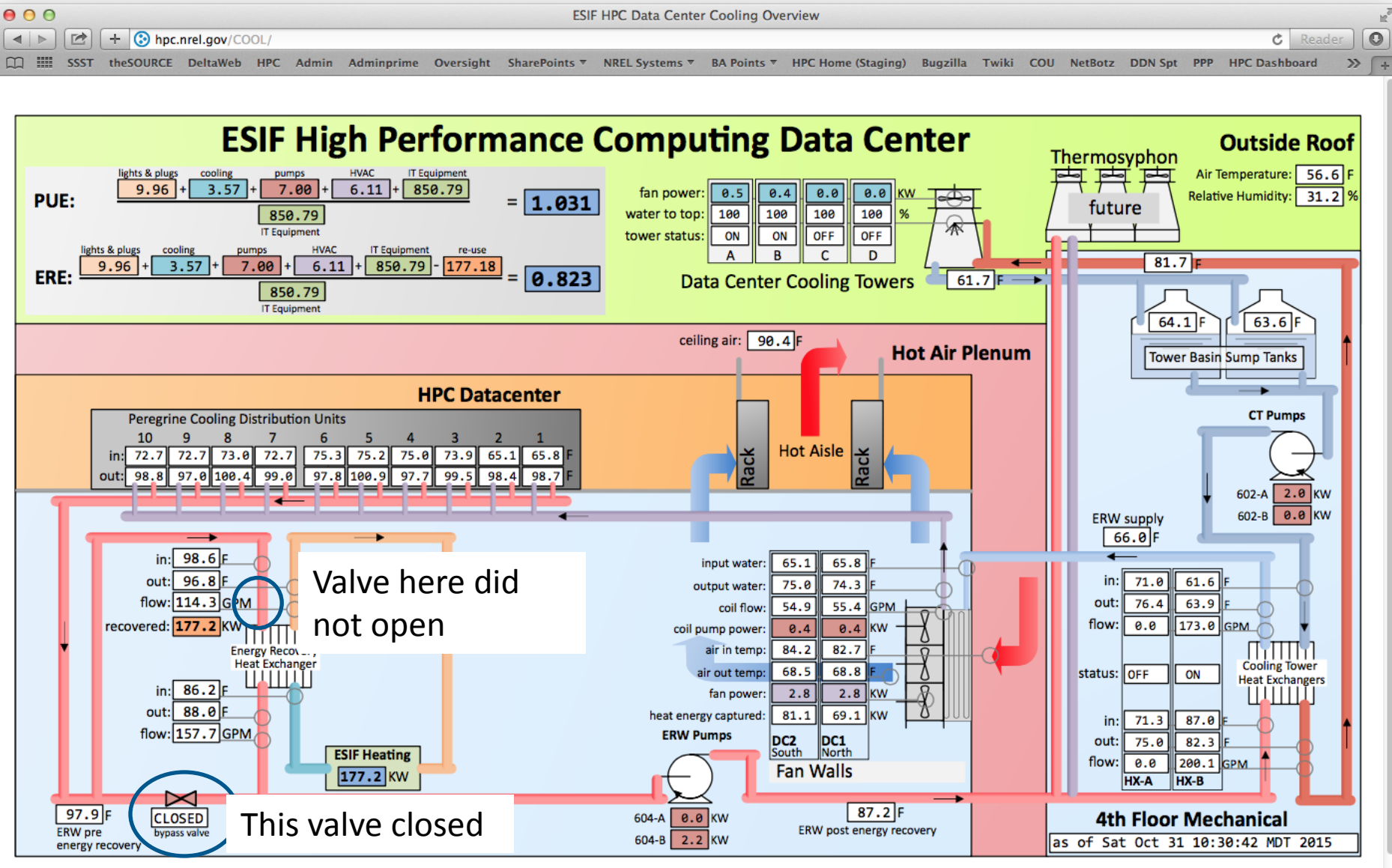
Event 2: May 14 – Learnings

- Test changes to state/configuration carefully: Test valve close in response to BAS signal, **and** valve open in response to a BAS single.

- Utilize valve status sensors to confirm valve open before closing the parallel path.

- Water flowing out of the Data Center cooling towers and into the heat exchanger was not as cool as it should have been.

- As a result, water coming from the Data Center energy recovery water loop could not transfer as much heat to the water in the cooling tower loop.

- Between 04:11 and 05:11, temperatures in energy recovery loop were high but increasing gradually.

- Tower B – End switch on isolation valve failed to send a signal back to ramp up pump flow

- Tower C – Actuator on 3 way valve failed, locking valve open, which directed water directly into basin (minimal cooling effect).
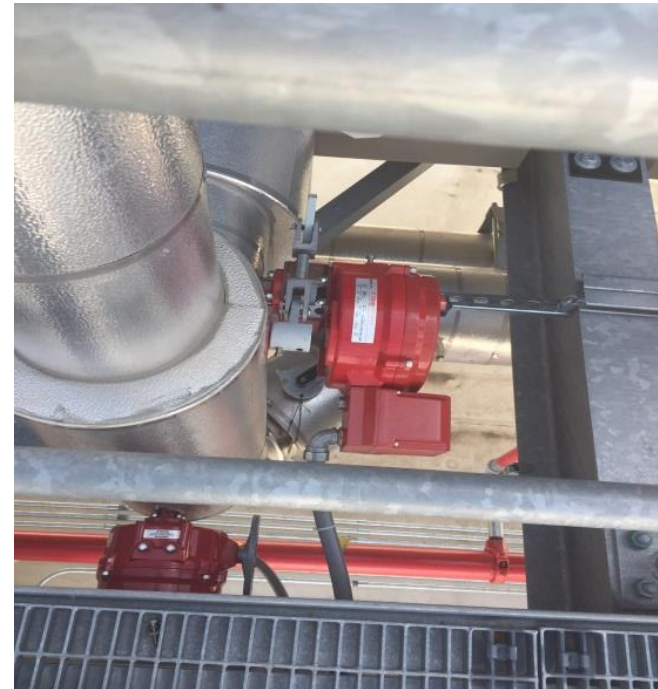
Event 3: May 27 – Learnings

- Preventative Maintenance Best Practice:
  - Specific checklist instead of general guidance so that tests are consistent and documented.
  - Test proper response to each control signal, and validate that sensor readings match.
- Improve Programming:
  - Alert when there is a mismatch between BAS signal and valve position sensors.

- ESIF cooling tower loop uses a remote sump tank design. When a tower is not in use, water drains down to a tank.

- Pumps draw their water from the bottom of the tank.

- Built in air separator right?

- BAS switched lead pump 09:00 (every Tuesday)
- 2 pumps ran through the day until about 17:30
- Temperature alarm at 18:06. ERWS water to CDUs passed 71F degrees.
- 18:13 returned to normal
- 19:00 temperature alarm again
- 19:06 returned to normal

- Why: lead pump became air bound. BAS started 2nd pump when temperatures got high enough to return to normal.

Event 4: August 25– Learnings

- Install automatic air purge devices. The ports are probably already there.

- Set up BAS alerts when pump speed and measured flow are inconsistent.